

Excess Plutonium Disposition Using a Sintered Ceramic Waste Form

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This paper describes an approach for the acceptable disposition of excess plutonium materials in a manner which minimizes technological risk, expense, public concern, and delay for the Department of Energy. Of particular concern is the desire to minimize the need for new facility design and construction and developmental efforts while efficiently managing the effective disposition of declared DOE excess fissile materials. This is accomplished by an optimized combination of 1) existing light water reactor burn for the recovered Pu from site-return pits and 2) immobilization using a compatible sintered ceramic waste form for discard of the contaminated Pu. Key to this approach is the use of a sintered ceramic waste form which will have a high probability of being acceptable for Federal Waste Management Facility disposition and which can be fabricated using the same basic technologies, processing equipment, and facilities which are used to fabricate the MOX reactor fuel.

Diversion protection for the waste form plutonium is achieved by association and coupling of the sintered ceramic disposition form with the reactor MOX fuel, both during fabrication, storage, shipping, and finally eventual packaging for disposal with the spent fuel at the Federal Waste Management Facility. The radiation barrier, which achieves the intent of the spent fuel standard, is provided by the spent MOX fuel and is implemented by including the sintered ceramic disposition form with the spent MOX fuel in the final welded multi-purpose container (MPC).

The combined disposition of contaminated plutonium in a sintered ceramic waste form with the MOX burn of clean plutonium has the following advantages:

1. The sintered ceramic disposition form mimics the chemical and morphological form of spent nuclear fuel and is expected to have similar repository impacts over geological time. To the extent that spent fuel is acceptable for repository disposition, the sintered waste form should also be acceptable.

2. The sintered ceramic disposition form utilizes facilities and technologies which are common to the MOX fuel fabrication operations, thus minimizing new required facilities or new technology development and demonstration.
3. The combination of the sintered ceramic waste disposition form with a light water reactor burn allows minimum processing of excess Pu feed materials.
4. The sintered ceramic disposition waste form provides an avenue for ready disposition of the TRU scrap generated during the recovery of Pu from pits and the subsequent MOX fabrication residues and avoids additional processing facilities or operations for recovery of these residues.
5. Radiation barriers and the achievement of the "spent fuel standard" can be readily implemented without the need for handling high level waste, ^{137}Cs , or hot cell operations beyond those utilized for normal reactor spent fuel handling.
6. The inclusion of the sintered ceramic waste form with the MOX spent fuel in the multi-purpose cask at the reactor site minimizes hot handling and uses existing reactor facilities, equipment, and techniques to achieve the diversion protection equivalent to the "spent fuel standard".
7. Up-front costs are minimized, both for capital construction, research, development, and demonstration.
8. MOX fuel fabrication and burn in a reactor can be time phased with the production of the sintered ceramic waste form fabrication to best utilize facility capacity and allow optimum schedules to be implemented.
9. A smaller number of total facilities (already in existence) are required to achieve completion of disposition on a timely basis.

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